CLAIMS

What is claimed is:

1. A method of making a diamond composite heat spreader comprising the steps of:

   a) providing a first plurality of diamond particles having a first average mesh size;

   b) packing the diamond particles such that each diamond particle is substantially in contact with at least one other diamond particle;

   c) providing an interstitial material; and

   d) bonding the packed diamond particles with the interstitial material such that the interstitial material at least partially fills any voids between the packed diamond particles.

2. The method of claim 1, wherein the step of bonding is performed by electro-deposition of the interstitial material.

3. The method of claim 1, wherein the step of bonding is performed by sintering of the interstitial material.

4. The method of claim 1, wherein the step of bonding is performed by infiltration by the interstitial material.

5. The method of claim 4, wherein infiltration is performed at a temperature below about 1,100° C.

6. The method of claim 4, wherein infiltration is performed in a vacuum furnace at a pressure below about 10^{-3} torr.

7. The method of claim 1, wherein the step of packing further comprises packing diamonds to over 50% by volume of the heat spreader prior to providing an interstitial material.

8. The method of claim 1, wherein prior to the step of providing an interstitial material, the method further comprises the step of adding a second plurality of diamond particles having a second average mesh size smaller than the first mesh size to the packed

diamond particles such that the second plurality of diamond particles at least partially fill in the voids between the larger particles to produce a packed collection of diamond between about 50% and about 80% by volume of diamond.

9. The method of claim 8, wherein the second mesh size particles have a diameter smaller than about 1/3rd the diameter of the first average mesh size particles.

10. The method of claim 9, wherein the second mesh size particles have a diameter of between about 1/5th and about 1/10th the diameter of the first average mesh size particles.

11. The method of either claim 1 or 8, wherein the diamond particles contact one another sufficiently to provide a continuous diamond-to-diamond path to substantially each of the plurality of diamond particles.

12. The method of either claim 1 or claim 8, further comprising the steps of:

a) providing a porous ceramic material prior to the step of bonding; and

b) placing the ceramic material adjacent to the packed diamond particles prior to the step of bonding.

13. The method of claim 12, wherein the ceramic material comprises at least 50% by volume of a member selected from the group consisting of SiC, Si_3N_4, Al_2O_3, WC, and ZrO_2

14. The method of claim 13, wherein the interstitial material is copper and wherein the step of bonding is performed at a pressure between about 4 GPa and about 6 GPa.

15. The method of claim 1, wherein the diamond particles have a size of from about 18 mesh to about 400 mesh.

16. The method of claim 1, wherein the interstitial material includes a component selected from the group consisting of Ag, Cu, Al, Si, Fe, Ni, Co, Mn, W, and mixtures or alloys thereof.

17. The method of claim 16, wherein the interstitial material is selected from the group consisting of Fe, Ni, Co, and mixtures or alloys thereof.

18. The method of claim 17, wherein the interstitial material is a Ni alloy selected from the group consisting of Ni-Cr-B and Ni-Cr-P.

19. The method of claim 17, wherein the interstitial material is a Fe, Ni, or Co alloy of a material selected from the group consisting of Ti, Zr, and Cr.

20. The method of claim 16, wherein the interstitial material is selected from the group consisting of Al, Cu, Ag, and mixtures or alloys thereof.

21. The method of claim 16, wherein the interstitial material is a Si alloy of a member selected from the group consisting of Ni, Ti, Al, and Cr.

22. The method of claim 1, wherein the interstitial material acts as a diamond-to-diamond sintering aid.

23. The method of claim 22, wherein the interstitial material is copper.

24. A method of removing heat from a heat source comprising the steps of:

a) providing a diamond heat spreader comprising a plurality of diamond particles, each substantially in contact with at least one other diamond particle and an interstitial material that substantially binds the plurality of diamond particles into a composite mass; and

b) positioning the heat spreader in operative connection with the heat source.

25. The method of claim 24, wherein the heat source is a CPU.

26. A method of making a diamond heat spreader comprising the steps of:

a) providing a first plurality of diamond particles having a first average mesh size;

b) packing the diamond particles such that the diamond particles intimately contact one another;

c) providing an interstitial material; and

d) sintering the plurality of diamond particles in the presence of the interstitial material at a pressure between about 4 GPa and about 8 GPa such that the diamond particles partially sinter together to provide a substantially sintered mass of diamond particles having a composition of between about 70% and about 98% by volume of diamond.

27. The method of claim 26, wherein the interstitial material comprises a component selected from the group consisting of Si, Ti, Ni, Fe, Co, Cu, Mn, Cr, Al, La, Ce, and mixtures or alloys thereof

28. The method of claim 26, wherein the diamond heat spreader has a composition of between about 90% and about 98% by volume of diamond.

29. The method of claim 26, further comprising the step of adding a second plurality of diamond particles having a second average mesh size smaller than the first average mesh size to the packed diamond particles such that the second plurality of diamond particles partially fill in the voids between the larger particles to produce a packed collection of diamond between about 50% and about 80% by volume of diamond.

30. The method of claim 29, wherein the second average mesh size particles have a diameter of between about $1/5^{th}$ and about $1/10^{th}$ the diameter of the first average mesh size particles.